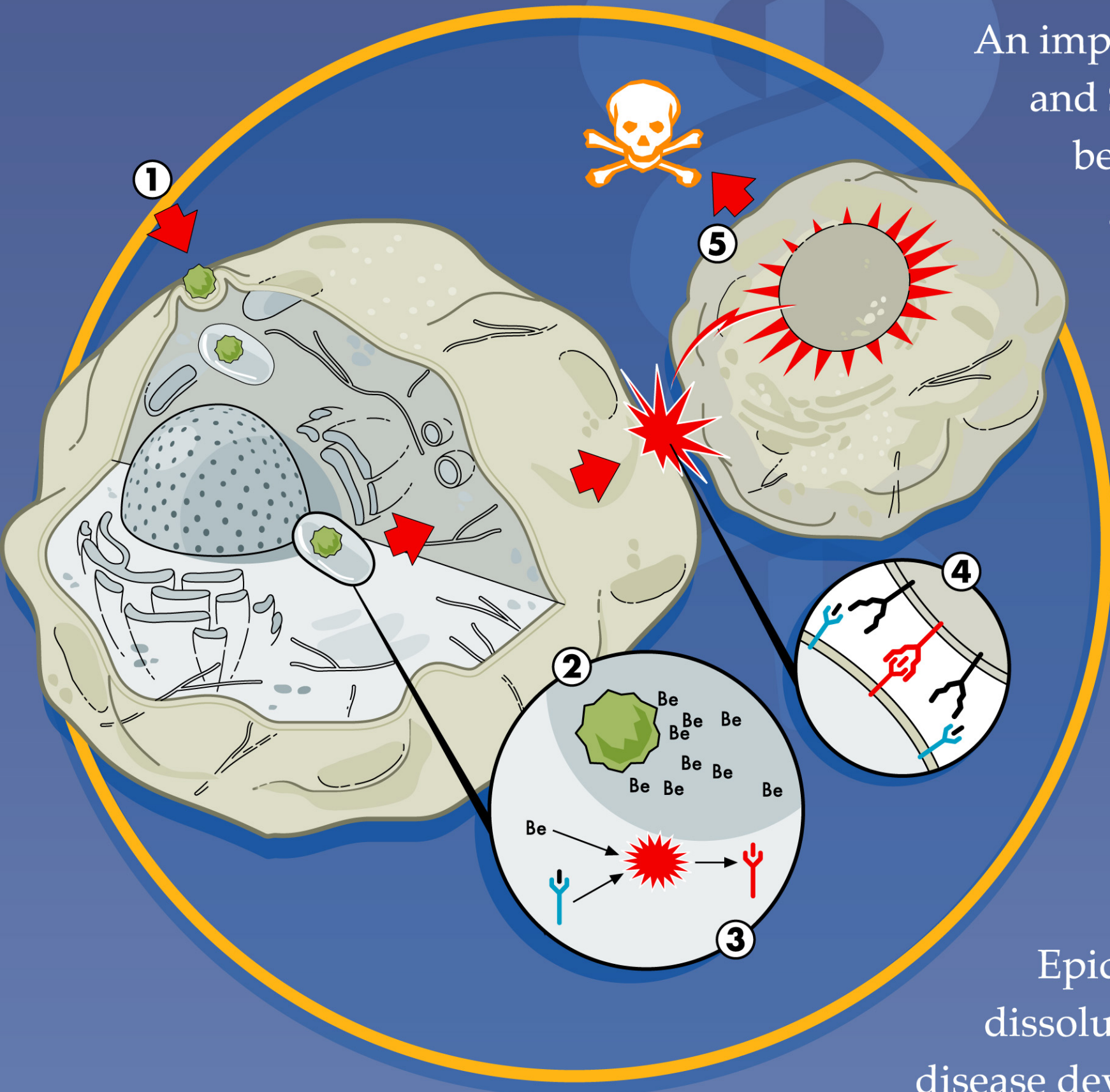


Improving Beryllium Worker Safety

Do dissolution rates of beryllium particles affect the incidence of chronic beryllium disease?

Chronic beryllium disease (CBD) is a debilitating and sometimes fatal immune disease of the lung caused by exposure to airborne beryllium particles. Respirable beryllium particles are generated by refining and processing beryllium for many applications, including components for the aerospace industry and weapons research. If those particles are inhaled, some people develop sensitivity to beryllium. In many cases, this sensitivity leads to a chronic inflammation that results in development of tumor-like masses in the lung called granulomas. The granulomas scar the lung, reducing its capacity to bring in air. Disease may occur years after a worker inhales beryllium particles.



An important research project in the Industrial Hygiene and Safety Group is a comprehensive study of respirable beryllium particles, prompted by new cases of CBD among beryllium workers, and even among some workers remote from beryllium operations. New cases occur despite 50 years of compliance with an occupational exposure limit based on the airborne mass concentration of beryllium particles. We study the rate at which beryllium particles that cause CBD dissolve under the hypothesis that this rate determines disease development. Our research could lead to an exposure limit based on particle dissolution that would better protect the health and safety of beryllium workers at Los Alamos, in industry, and around the world.

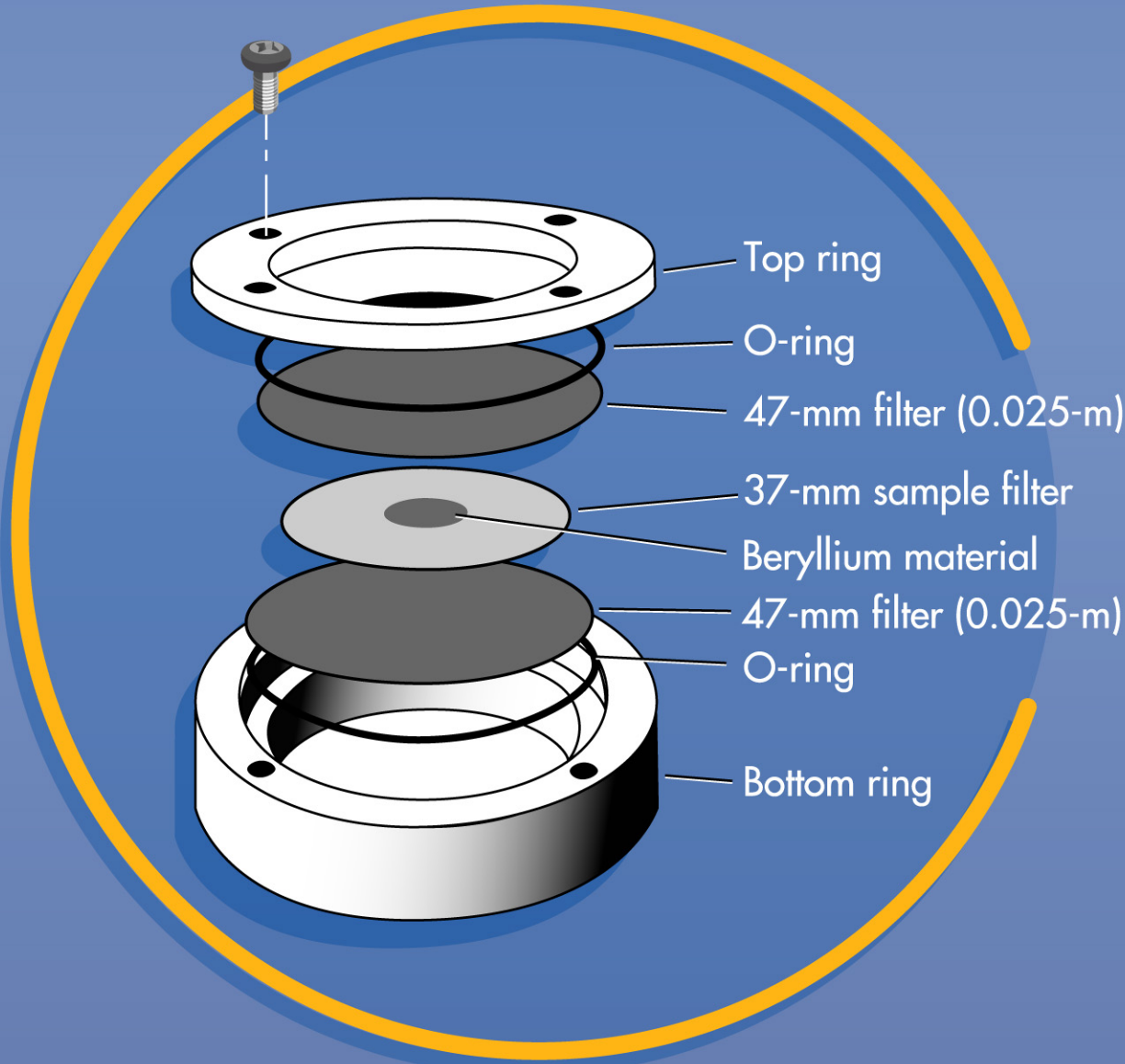
Lung Cell Engulfs and Processes Beryllium Particle

(1) Beryllium particles deposited in the lung are engulfed by antigen-presenting immune cells. (2) Inside these cells, the particles begin to dissolve. (3) The dissolved beryllium causes a change in some immune molecules. (4) These molecules are expressed on the cell surface and presented to T cells, which recognize the change. (5) The T cells then initiate the pathology that ultimately results in lung damage. We hypothesize that CBD develops only when the dissolution rates of beryllium particles fall within a critical range. At higher dissolution rates, beryllium particles dissolve before the chronic inflammation needed to develop granulomas is established. At lower rates, there is insufficient dissolved beryllium to initiate inflammation.



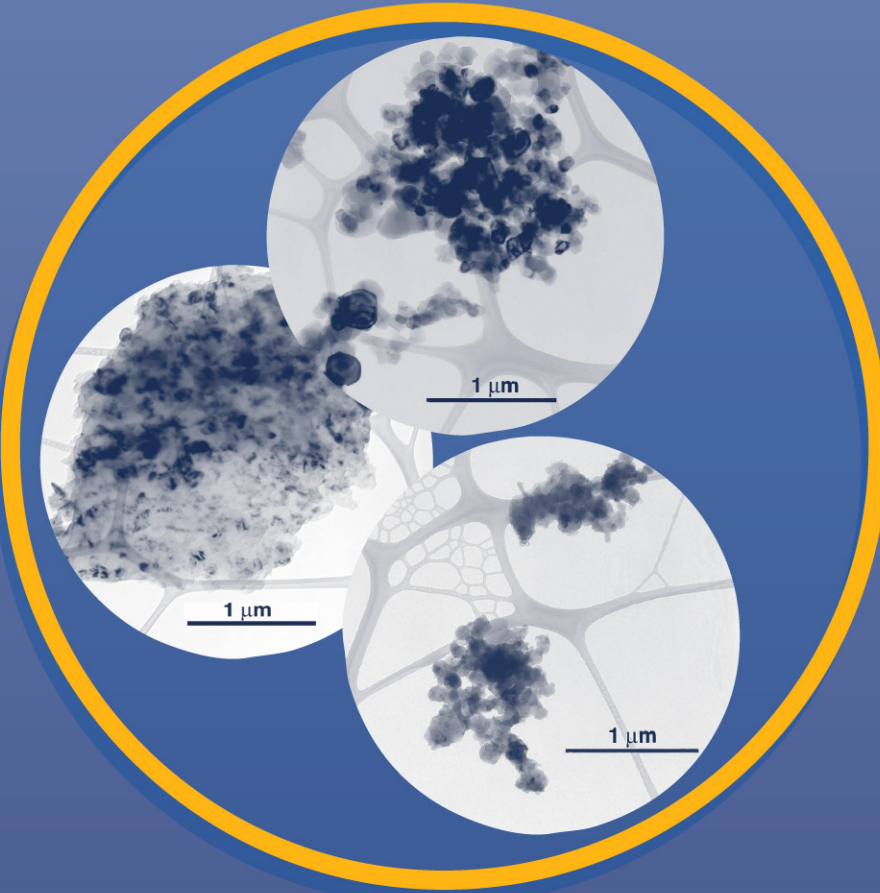
Machining beryllium material

Epidemiologic results indicate that the rate of particle dissolution within immune cells may determine whether disease develops. We continue to work with the Bioscience, Chemistry, Theoretical, and Materials Science and Technology Divisions at the Laboratory and with several external organizations—Lovelace Respiratory Research Institute, Brush Wellman, Inc., and the National Institute of Occupational Safety and Health—to evaluate the validity of this hypothesis. Two of our recent publications garnered awards from the *Journal of Environmental Monitoring* and the American Industrial Hygiene Association.



Measuring Beryllium Dissolution Rates

Particulate beryllium material is placed on the sample filter in the center of the chamber. The chamber is closed and then submerged in a solution that simulates the fluid in which intracellular particle dissolution takes place. Beryllium dissolved from particles penetrates the barrier filters and is measured in the solution. Beryllium dissolution rate was determined from the mass of beryllium dissolved in a given time, and it was found to depend on beryllium chemical form and surface area.



Beryllium Aerosol Particles That Caused CBD

Beryllium aerosol particles were collected from processes that triggered CBD to determine the beryllium dissolution rate range in which CBD develops. Additional studies are being conducted on other beryllium aerosol materials whose inhalation has not led to CBD so far. The three particles shown are from beryllium aerosol materials that are known inhalation hazards.



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